NextGEN

OPERATIONAL PERFORMANCE ASSESSMENT

EXECUTIVE SUMMARY

SEPTEMBER 2015

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This report provides an overview of recent FAA Next Generation Air Transportation System (NextGen) improvements and the corresponding operational impacts observed in the National Airspace System (NAS). The FAA's objectives are to determine if the desired impacts were achieved, quantify these impacts, and identify any unanticipated effects.

The FAA's NextGen office focused on a select set of NextGen improvements implemented by fiscal year 2015. They are Houston Metroplex, wake recategorization, enhanced low-visibility operations and improved data sharing. We included the implementations for which sufficient time has passed to conduct a meaningful analysis. Our aim was to estimate the impacts of NextGen capabilities on airspace operations in a systematic and standardized way.

HOUSTON METROPLEX

The FAA implemented multiple changes to the first key metroplex location in Houston on May 29, 2014. Houston metroplex includes two major and 16 satellite airports, a complex airspace consisting of segments controlled by two center air traffic control (ATC) facilities and a major terminal ATC facility, and several Class D airspace units. Houston Metroplex improvements incorporated minor airspace adjustments and numerous changes to the procedures for Houston Intercontinental (IAH) and Houston Hobby (HOU) airports, including publication of 49 new Performance Based Navigation procedures, modification of 11 existing procedures, and elimination of 20 procedures. In addition, traffic to IAH and HOU is now supported by Time Based Flow Management automation, which continues to be adjusted in response to the new routing structure and still developing operating practices.

In early 2015, MITRE Corp. completed a post-implementation review of Houston Metroplex improvements and estimated an annual benefit of $6.1 million to the operators at the two largest airports in the area. Our analysis complements MITRE's study by highlighting continuous descent operations and encompassing impacts observed over a longer study period. We focused on operational and performance impacts, and did not attempt to monetize the corresponding savings.

Since the implementation of Houston Metroplex improvements, both IAH and HOU can accommodate more operations during peak hours despite a decrease in facility reported airport departure and arrival rates. Also, IAH now accommodates about 10 more and HOU three more operations per hour during instrument meteorological conditions. However, improved airport efficiency has not yet led to improvements in flight efficiency on the airport surface.

Trade-offs in airborne flight efficiency were prominent for both arrivals and departures. Although arrivals now fly up to 1.6 percent longer distances within 300 nautical miles (nm) of the two airports, their cruise is longer and descent more efficient. Longer cruise and shorter descent phases of flight mean longer time and distance spent at higher, more fuel-efficient altitudes, and consequently more efficient flight profiles. Departures fly up to 1.1 percent longer distances within 300 nm of the two airports and experience a 4.0-5.5 percent longer cruise as well. However, cruise altitude is about 700 feet lower on average.

Because one of the key goals of Houston Metroplex improvements was to facilitate continuous descents into IAH and HOU, we investigated changes in descent profiles more carefully. Arrivals are over three times more likely to execute continuous descents – the rate of continuous descent operations increased from 13 to 41 percent of all arrivals to the airports – with their top of descent (TOD), the point at which an aircraft transitions from the cruise to the descent phase of flight, about 13 nm and two minutes closer to the two airports. Impacts on flights with step descents were mixed, with their TOD about 4 nm farther away from the two airports and time in level flight below TOD three minutes longer on average. However, flights with step descents now level off at over 3,000 feet higher altitude on average.

Arrivals from San Antonio are the biggest beneficiaries of improvements introduced through the Houston Metroplex project, with average distance and time savings of 3 nm and 41 seconds, nearly a fourfold increase in the proportion of flights executing continuous descents, and more than 1,000 foot increase in altitude of level segments.

Area Navigation (RNAV) Standard Terminal Arrival use is high across the board, with more than 55 percent of arrivals to the two airports conforming to more than 80 percent of the filed procedure portions. Use of RNAV standard instrument departures is lower because of a heavy use of direct-to clearances: about 30 percent of departures from IAH and 15 percent of departures from HOU conform to more than 80 percent of the procedure after the joining waypoint.

WAKE RECATEGORIZATION

Air traffic controllers in the United States currently use two classifications and sets of separation standards to avoid wake turbulence from nearby aircraft during approach and takeoff: traditional and recategorized wake classes (RECAT). While the traditional wake separation classes are based on maximum certified takeoff weight, the new RECAT categories also consider aircraft wingspan and ability to withstand a wake encounter. The new categories provide for less variation in weight, speed and wake characteristics among the aircraft belonging to the same category. As a result, separations for many aircraft-pair combinations can be safely reduced with RECAT, especially for aircraft belonging to the traditional Heavy and Boeing 757 classes.

Air traffic controllers took about three to four months to get comfortable with the new aircraft categorization and separations at the first four facilities authorized to use RECAT. At that point, they started declaring higher airport arrival and departures rates. Although the maximum rates generally increased, they were used infrequently. However, the high-end range of airport departure rates and airport arrival rates was used more frequently after RECAT, indicating that the controllers can now sustain a high-pressure workload for longer periods of time.

At Memphis (MEM), Louisville (SDF) and Cincinnati (CVG) airports, the average peak quarter-hour throughput increased by at least one departure and up to one arrival per runway. The highest increase in peak throughput was observed at MEM, equivalent to 13 additional operations per hour. This was partially caused by a significant growth of the Boeing 757 fleet. On the other hand, throughput improvement in ATL was hidden by reduced demand and the preponderance of aircraft less affected by RECAT. However, throughput of ATL's dominant Runway 27R increased by about two arrivals and two departures per hour, an improvement mostly driven by traffic spilling over from the crossing Runway 28, which is now less frequently used.

Departure queue delays decreased at the three locations with Airport Surface Detection Equipment-Model X (ASDE-X) surveillance: around three minutes at MEM and just under a minute at SDF and ATL. Average taxi-out times decreased as well, resulting in overall taxi-out time savings between 1.2 and 4.6 minutes.

For nearly all arrival fix-runway pairs, average time in terminal airspace decreased after deployment of RECAT separations. Since RECAT deployment and through the end of FY 2014, these savings accumulated to almost 93,000 minutes in ATL, while the overall savings during peak periods accumulated to about 12,000 minutes at MEM, 8,900 minutes at SDF and 1,200 minutes at CVG.

ENHANCED LOW-VISIBILITY OPERATIONS

During the last few decades, numerous airports across the NAS improved their runway guidance and lighting systems. Operators also invested in many cockpit technologies that enhance pilot awareness of their surroundings near and on the surface. For example, Head-Up Displays (HUDs) provide flight and navigation information on a clear panel that pilots can review while looking out the window. With this more integrated view in a single field of vision, pilots now can execute safe precision approaches during some of the low-visibility conditions that used to halt landings. Runway visual range (RVR) and decision height minima for approaches are now as low as 1,000 feet and 100 feet for Category II, and 1,400 feet and 150 feet for Category I approaches.

After reduction of RVR minima requirements, airport access during low-visibility conditions improved in two ways: periods of time with no access occur almost 6 percent less frequently and 17 percent more flights were able to land during such conditions.

Although these benefits were spread mostly across airports supporting Special Authorization (SA) CAT I operations, our study confirmed that facilitating SA CAT II operations results in a more significant benefit by enabling airport access during periods when none was previously available.

INFORMATION SHARING

NAS users rely on many types of information provided by the FAA. Some of that information is static and made available via products with regular publication cycles, such as aeronautical charts. However, we also are sharing more real-time data, such as surveillance, traffic flow management, weather observations and forecasts, and other dynamic updates, such as the status of special use airspace. The FAA traditionally shared such information using a variety of technologies, including radio, telephone, Internet, and dedicated connections. However, in recent years, we leveraged new information management technologies to improve information delivery and content.

Improved delivery typically results in lower costs while improved content should enable operational benefits. Operational impacts of these improvements will depend on the particular information needs of users. Improved outcomes arrive only when better information content and delivery are used to influence decisions. To determine how this information is being used, and what, if any, the benefits of using it may be, we interviewed data consumers.

Airlines and airports report using FAA data to improve their operations, with the most extensive use supporting enhanced awareness of operating conditions and flight status, especially on the airport surface and in situations when aircraft transition from the control of one entity to another. Improved awareness typically enables more proactive engagement with flight re-planning, including the ability to anticipate dynamically evolving conditions and events affecting individual flights as well as overall flows of traffic. All of this means improved resource management by the data consumers, especially when supported by automated decision support tools and ex post analytical capability.

Airlines and airports also report increased benefits when integrating multiple complimentary data sources. For example, ASDE-X surface surveillance data can be displayed alone, but it also can be combined with actual and scheduled time information to yield useful decision-support applications. On the other hand, users said that aeronautical information about airspace restrictions will be more useful once it is fully digitized and combined with planned flight trajectories in various decision support tools.

While users reported using data from the System Wide Information Management Terminal Data Distribution System and Traffic Flow Management System the most, they also were interested in additional data products once they become more mature. Our research confirms that obtaining the live subscriptions is only the first step; this needs to be followed by developing parsers, displays and automation before the data becomes truly useful. External users now consume just a subset of the data that has been made available. Some of the data elements are new and require time for users to understand their potential for practical use. Also, the cost of developing tools that transform this data into valuable information remains the key impediment to more extensive use.

Because the FAA shares the data free of charge, there has always been a question about its actual value. End users either invest their own time and money to connect to and parse the data or pay a third-party vendor for the service. This is only a partial picture of the value proposition, and in any case, the amount spent on these transactions was unavailable to inform our study.

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